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ORIGINAL ARTICLE

Does reconstruction of isolated chronic posterior cruciate ligament injuries restore normal knee function?

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KEYWORDS
Posterior cruciate ligament reconstruction;
Chronic posterior instability

Summary
Introduction: Isolated posterior laxity is most often cared for with conservative functional treatment. However, when there is pain or instability, surgical treatment can legitimately be proposed. The objective of this study was to assess the results of surgical treatment for chronic isolated posterior laxity.
Hypothesis: Surgical treatment of direct posterior laxity re-establishes sufficient anatomical integrity to stabilize and provide good function to the knee.
Material and methods: This was a retrospective, continuous, single-operator study. Eleven operated patients were retained for this study, all followed up a mean 20.9 months, with a minimum follow-up of 1 year. Subjective and clinical assessments were carried out using the International Knee Documentation Score (IKDC) score. Surgical correction of posterior laxity was measured clinically and radiologically.
Results: The subjective IKDC score increased from 53 preoperatively to 68.5 at the last follow-up ($P = 0.006$). For the objective IKDC score, all knees were classified C or D preoperatively; at the last follow-up, six were A or B and none D. All the knees had preoperative Clancy grade 2 or 3 laxity; after surgery, there were three. According to the IKDC laxity score, eight knees were classified A or B at the last follow-up. The radiographic workup noted a 48.6% ($P = 0.05$) posterior laxity correction on the TELOS™ test.
Discussion: Posterior cruciate ligament reconstruction provides partial correction of posterior laxity. However, the subjective result remains insufficient, providing acceptable function for daily life activities but not sports activities.
Level of evidence: Level IV, retrospective study.

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Introduction

Direct posterior laxity poses a different problem from postero-posterolateral laxity. In the majority of cases, functional treatment is recommended. However, in some cases, notably when there is pain or instability, surgical treatment can be proposed. Even though the level of evidence reported in the literature is insufficient, the long-term natural history of posterior laxity, usually well tolerated, can develop into osteoarthritis [1], medial tibiofemoral osteoarthritis [2] and/or patellofemoral osteoarthritis [3,4].

The physiological position of the tibia under the femur is maintained by the cruciate ligaments. The posterior cruciate ligament (PCL) is the main ligament preventing the tibia sliding back. When this ligament presents an isolated lesion, direct posterior laxity (DPL) can appear. Surgical reconstruction aims to reduce this posterior drawer.

The objective of this study was to evaluate the surgical treatment of DPLs. We tested the hypothesis that surgical DPL treatment re-establishes sufficient anatomical integrity to stabilize and provide good function to the knee. To respond to this question, we conducted a retrospective study in a series of patients with a minimum follow-up of 1 year. Our main evaluation criterion was the knee's functional state based on both a subjective and a clinical examination. The secondary criterion was the correction of the laxity as evaluated by clinical and radiological examination.

Material and methods

This was a retrospective, continuous study in which all patients operated between September 1995 and November 2003 for isolated, chronic posterior laxity by one of the senior surgeons (PC) were reviewed. The inclusion criteria were patients operated for DPL with a minimum follow-up of 12 months. These were patients who had a clinical repercussion from their PCL rupture, either medial tibiofemoral or patellofemoral pain and/or functional instability with the sensation of the knee sliding towards the back. The exclusion criteria were rupture of both cruciate ligaments, combined rupture of the PCL in the posteromedial plane and/or the posterolateral plane, the presence of femorotibial arthritis, or a posterior drawer that could not be reduced at the clinical examination.

Eleven patients (seven males and four females), mean age, 31.5 years (range, 19.5—45.3 years), were retained. In five patients, the lesional mechanism was a traffic accident and in six a sports accident.

The clinical diagnosis of PCL rupture for all the patients included a posterior drawer test at 90° flexion in different rotations and in external and then internal rotation [5]. Spontaneous posterior subluxation of the tibia quantified the severity of the laxity according to the Bisson and Clancy classification [6] (Table 1). Each clinical examination was recorded on an International Knee Documentation Committee (IKDC) chart [7]. A subjective IKDC assessment quantified the knee function with a score ranging from 0 to 100. Differential posterior laxity compared to the healthy side was quantified using two dynamic X-rays, one posterior stress X-ray using the TELOS™ device with a 25-kg load applied and the other with the hamstring muscles contracted. For each dynamic X-ray, posterior tibial translation was measured at the posterior intercondylar area compared to the posterior condyles. After 2000, the axial view 70° flexion as described by Puddu et al. [8] was added. The frontal axis was evaluated using a lower-limb X-ray with load.

Table 1 Clancy classification (90° knee flexion).

Grade	
0	Normal knee
1	Injuries to the anterior tibial crest remained 5 mm anterior to the femoral condyles, but had dropped back compared to the contralateral normal knee
2	The tibial crest was flushed with the femoral condyles. The posterior tibial displacement is between 5 and 10 mm
3	The tibial crest lay behind the femoral condyles. The posterior tibial displacement is greater than 10 mm

All patients had arthroscopic double-bundle PCL ligament reconstruction [9—14]. The transplant was a bone patellar tendon — bone transplant in one case and a quadriceps tendon graft in the 10 other cases. No peripheral reconstruction or tibial osteotomy was performed.

The patients followed a strict rehabilitation protocol based on closed-kinetic chain exercises [15—17]. The patients were in immediate total weight bearing with a custom-designed adjustable articulated knee brace. The open-kinetic chain exercises of the hamstrings began only after the fourth postoperative month.

All patients were reviewed with a mean follow-up of 20.9 months (range, 12—41 months) with a subjective IKDC questionnaire and a clinical examination recorded on the IKDC form. Dynamic X-rays (TELOS™ and contracted hamstrings) and an axial view 70° were also taken. We defined gain in laxity by the differential between the measurements

Table 2 Preoperative and postoperative X-ray assessment (mm) and gain in knee laxity.

	Preoperative	Postoperative	Gain (%)	**
HC 90°	6.9 mm (1—14)	4.4 mm (1—13)	36.2	NS
Posterior TELOS™ 90°	3.7 mm (—3 to 9)	1.9 mm (—2 to 6)	48.6	0.05*
AV 70°	7.5 mm (3—17)	4.8 mm (—4 to 10)	36	NS

*$P < 0.05$ is significant; ** P-value calculated with Wilcoxon nonparametric test; NS: not significant; HC: hamstring contraction; AV: axial view.

of the preoperative and postoperative differentials recalculated to the preoperative differential measurements.

Statistical analysis was carried out using Stat View™ 5.0.0 (SAS Institute NC® 1992—1998, Cary, NC, USA). Paired data were analyzed within each group using the nonparametric Wilcoxon. The significance threshold chosen was 5%.

Results

Complications

No complications were observed.

Subjective assessment

The mean subjective IKDC score increased from 53 (range, 25—98) preoperatively to 68.5 (range, 22—94) at the last follow-up ($P = 0.066$). One patient's subjective score worsened by more than 20 points, even though laxity had improved both clinically and radiologically.

The subjective IKDC score was compared to the IKDC symptom score: at the last follow-up, nine patients no longer presented pain and two had retained some noninvalidating pain. The analysis of the IKDC questionnaire brought out resuming sports activities as a factor limiting a very good result.

Objective clinical examination

The mean preoperative mobility values were 4° extension and 130° flexion. At the last follow-up, they were 2° extension and 128° flexion.

The overall clinical IKDC results are presented in Fig. 1. Before surgery, seven knees were classified C and four D; at the last follow-up, six knees were classified A or B and five C.

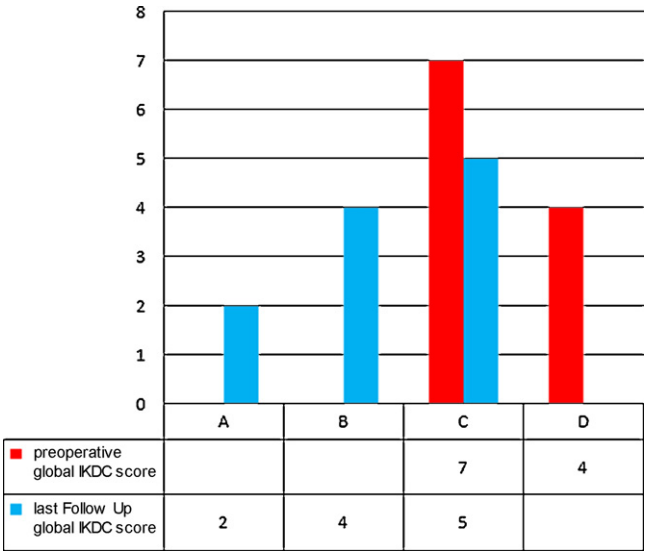

Figure 1 Overall International Knee Documentation Score.

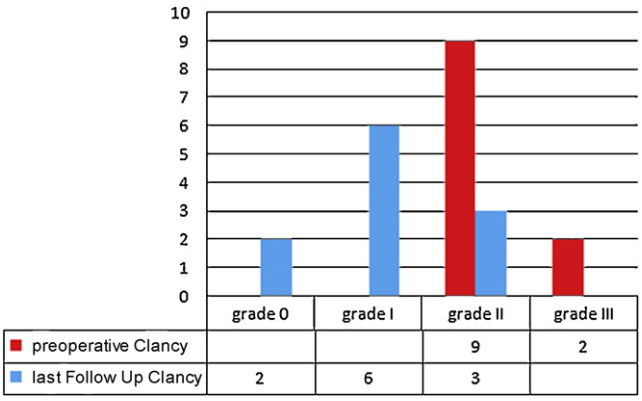

Figure 2 Clancy's classification.

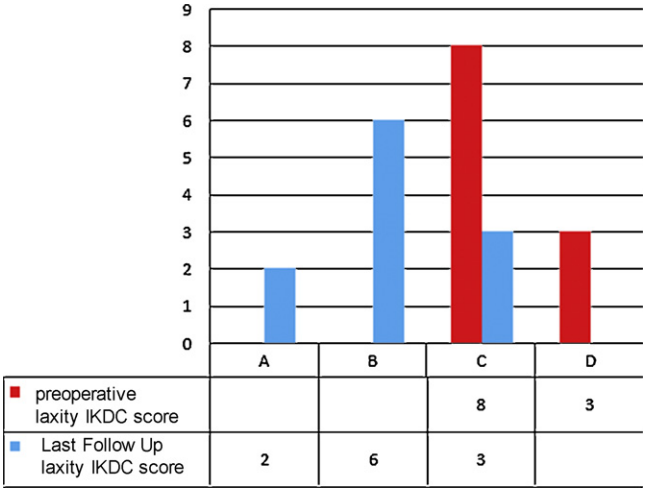

Figure 3 International Knee Documentation Score laxity score.

Laxity assessment

On the Clancy classification (Fig. 2), preoperatively, nine knees were grade 2 and two grade 3. At the last follow-up, two knees had no spontaneous posterior drawer, six were grade 1, and three grade 2.

According to the IKDC laxity score (Fig. 3), preoperatively, three knees had laxity classified D and eight classified C; at the last follow-up, eight had laxity graded A or B and none was graded D.

The gain in laxity on the TELOS™ stress test (Table 2) was 48.6% ($p = 0.05$). The gains calculated on the 70° axial films and with the hamstring muscles contracted were 36% and 36.2%, respectively.

Discussion

Surgical treatment of DPL with intra-articular PCL reconstruction corrects posterior drawer with a mean subjective IKDC score of 68.5, 73% good to very good objective clinical results, and a significant gain in radiological laxity of 49% on the posterior TELOS™ test.

The strong points of this study are the single-observer clinical evaluation and an unequivocal surgical tech-

Table 3 Literature review.

Author	Journal	Year	Study design	*n*	Graft	Technique	Follow-up (months)
Wu et al. [25]	Arthroscopy	2007	Prospective	22	QT	Arthroscopy	66 (60—76)
Chan et al. [19]	Arthroscopy	2006	Prospective	20	HT × 4	Arthroscopy	40 (36—50)
Chen [20]	Arthroscopy	2002	Retrospective	24	QT	Arthroscopy	30 (24—36)
Chen [20]	Arthroscopy	2002	Retrospective	30	HT × 4	Arthroscopy	26 (24—30)
Ahn et al. [18]	Arthroscopy	2005	Retrospective	18	HT × 4	Arthroscopy	35 (28—55)
Ahn et al. [18]	Arthroscopy	2005	Retrospective	18	Achilles allog.	Arthroscopy	27 (24—36)
Deehan [21]	Arthroscopy	2003	Prospective	27	HT × 4	Arthroscopy	40 (24—64)
Zhao et Huangfu [26]	Knee	2007	Retrospective	21	HT × 4	Arthroscopy	31
Zhao et Huangfu [26]	Knee	2007	Retrospective	22	HT × 7	Arthroscopy	30
Hermans. et al. [22]	Am J Sp Med	2009	Retrospective	22	BTB/HT/Achilles allog.	Arthroscopy	109 (78—151)
Garofalo et al. [27]	Arthroscopy	2006	Retrospective	15	BTB + HT	Arthroscopy	38 (24—60)
Lim et al. [23]	KSSTA	2009	Retrospective	22	Achilles allog.	Arthroscopy	33 (24—60)
Sekiya et al. [24]	Arthroscopy	2005	Retrospective	21	Achilles allog.	Arthroscopy	71 (31—132)
Our study	OTSR	2010	Retrospective	11	QT/BTB	Arthroscopy	21 (12—41)

QT: quadriceps tendon; HT: hamstring tendon; BTB: bone—tendon—bone; Achilles allog.: Achilles allograft.

Table 4 Literature outcomes of DPL surgical treatment.

Author	Lysholm		Tegner		Subjective IKDC[a]		Objective IKDC		Clancy		TELOS™ (mm)	
	Pre	FU	Pre	FU	C/D pre	A/B FU	C/D pre	A/B FU	3 + 4 Pre	1 + 2 FU	Pre	FU
Wu et al. [25]	67	89	3	6		82 %	100 %	82 %				
Chan et al. [19]	63	93	3	6.3		85 %	100 %	85 %	100 %	95 %		
Chen et al. [20]		90				86 %		82 %				
Chen et al. [20]		91				85 %		81 %				
Ahn et al. [18]	68.2	90.1					100 %	89 %			14.3	2.2
Ahn et al. [18]	68.6	85.8					100 %	78 %			13.8	2.9
Deehan et al. [21]	64	94			77 %	92 %	100 %	67 %				
Zhao et Huangfu [26]		83						76 %	100 %	76 %		
Zhao et Huangfu [26]		92						91 %	100 %	91 %		
Hermans et al; [22]	50	75		5.7	38 %	65						4.7
Garofalo et al. [27]	61	87.5	2	7.9	37 %	66	100 %	61 %	100 %	87 %	12.6	5.9
Lim et al. [23]	64	88	3	6	100 %	88 %					11	3
Sekiya et al. [24]						57 %				50 %		
Our study					53	68.5	100 %	54 %	100 %	79 %	3.7	1.9

IKDC: International Knee Documentation score; pre: preoperative; FU: follow-up; QT: quadriceps tendon; HT: hamstring tendon; BTB: bone—tendon—bone; Achilles allog: Achilles allograft.
[a] IKDC subjective results are expressed as a score out of 100 or in % of A/B and C/D classification.

nique performed by a single operator. The multiplicity of the complementary examinations applied to all the patients has made it possible to cross the results. The study's main limitations include its retrospective design, the short follow-up period, and the small number of patients, which precluded establishing normal variables within this series and thus improve the significance of the results.

Ten studies [18—27] have reported the surgical results of DPL (Tables 3 and 4). They all report cohorts consisting of 15 to 30 patients, underscoring the rarity of the surgical indication in these DPL cases. All surgical treatments were arthroscopic and the different grafts involved the quadriceps tendon, the hamstring tendons, the patellar tendon, or Achilles tendon allografts. The results were equivalent for all types of graft [18,20,26]. The mean follow-up varied from 26 months [20] to 109 months [22] with a minimum follow-up of 24 months; our series was limited to a mean follow-up of 20.9 months with a 12-month minimum. The subjective Lysholm score [28] was applied in nine cases out of 10 and the Tegner score [29] in five cases out of 10; we did not use these scores in our study because we found them to be less well adapted to this population. The subjective IKDC is distributed either as A, B, C, D or as a recalculated score as in our series. Hermans [22] and Garofalo et al. [27] presented IKDC scores of 65 and 66, respectively, at the last follow-up, comparable to our result. Correction of posterior drawer according to the Clancy classification was studied by Chan et al. [19], Zhao et Huangfu [26], Garofalo et al. [27], and Sekiya et al. [24]: the percentage of patients classified in stage 1 or 2 at the last follow-up varied from 50% [24] to 95% [19]; it was 79% in our series. As for the TELOS™ posterior stress radiographic evaluation, interpretation of the results reported in the literature is delicate. Several series reported preoperative side to side difference greater than 10 mm: this level of differential raises the question of isolated PCL rupture. Ahn et al. [18] presented a preoperative differential laxity of 14.3 and 13.8 mm, Garofalo et al. [27] and Lim et al. [23] 12.6 and 11 mm, respectively. Our preoperative differential laxity was a mean 3.7 mm. Nevertheless, the final results varied from 5.9 to 2.2 mm at the last follow-up; with 1.9 mm in our series, the correction of the posterior drawer was satisfactory.

Although the posterior drawer contract was fulfilled, the subjective results are insufficient, with limitations mainly in sports activities.

Conclusion

Correction of posterior laxity by PCL reconstruction is satisfactory, with no morbidity related to the procedure. In agreement with the results reported in the literature, this correction is sufficient to obtain a functional knee for everyday activities but incomplete for recreational and particularly competitive sports.

Conflicts of interest statement

None.

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